

Decision Rationale

Total Maximum Daily Load of Fecal Coliform for the Lower Blackwater River¹

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Load (TMDL) of Fecal Coliform for the Lower Blackwater River submitted for final Agency review on March 27, 2001. Our rationale is based on the TMDL submittal document to determine if the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. The TMDLs have been subject to public participation.
8. There is reasonable assurance that the TMDLs can be met.

II. Background

Located in Franklin County, Virginia, the overall Blackwater watershed is approximately 108,000 acres. The Lower Blackwater River watershed comprises 20,504 acres. The TMDL addresses the 20.00 mile impaired segment. The impaired reach originates 1 mile south of the private bridge at the end of Rt. 921 and ends 3.9 miles downstream of the Rt. 834 bridge. Forest is the major land use and makes up roughly 58% of the 20,504 acre watershed.

In response to Section 303 (d) of the Clean Water Act (CWA), the Virginia Department of Environmental Quality (VADEQ) listed 20.00 miles of the Lower Blackwater

¹This typewritten version of the decision rationale was created after the close of the administrative record on April 27, 2001. It contains a transcription of hand written grammatical changes that were made to the document prior to the close of the record on April 27, 2001. The original document, with the hand written modifications, will be filed within the administrative record.

River as being impaired by elevated levels of fecal coliform on Virginia's 1998 Section 303 (d) list. The Lower Blackwater River was listed for violations of Virginia's fecal coliform bacteria standard for primary contact. Fecal coliform is a bacterium which can be found within the intestinal tract of all warm-blooded animals. Therefore, fecal coliform can be found in the fecal wastes of these animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

The Lower Blackwater River, identified as watershed VAW-L20R, was given a high priority for TMDL development. Section 303 (d) of the Clean Water Act and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the State where technology-based and other controls will not provide for the attainment of Water Quality Standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to the Lower Blackwater River, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)², in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

EPA has been encouraging the States to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli (and enterococci) and the incidence of gastrointestinal illness. The Commonwealth is pursuing changing the standard from fecal coliform to e-coli.

Virginia designates all of its waters for primary contact, therefore all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all flows. Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) were causing or contributing to violations of the standard during low flows. Thus many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the stream. The TMDL for the Lower Blackwater River did not call for any reductions in wildlife loading.

During the development of this TMDL, it was discovered that the model consistently under-represented the concentration of fecal coliform in these river segments. The model used for this TMDL duplicated the assumptions and loadings that were used for TMDL development in the four Upper Blackwater River segments (North Fork of the Blackwater, South Fork of the Blackwater, the Upper Blackwater, and Middle Segment of the Blackwater). As the assumptions made in the previous TMDLs resulted in a model that accurately reflected the concentrations of fecal coliform in the upper segments, it was felt that a change in the loadings would question the integrity of both studies. An unknown mechanism may be contributing to the elevated fecal coliform concentrations detected in this segment.

²Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

One possible mechanism for this discrepancy would be the resuspension of sediments. As documented in the report, fecal coliform concentrations in the sediment often far exceed the concentrations detected in the water column. An agent (cattle in-stream or other mechanism) causing a resuspension of these sediments may cause an elevation in fecal coliform concentrations. The model developed for this TMDL used a factor value based on the likelihood that cattle in-stream were causing the resuspension of fecal coliform in the sediment. The factor value was determined by dividing the stream access area by the sum of the pasture area and the stream width ³.

The HSPF model is a comprehensive modeling system for simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality for conventional pollutants and toxicants⁴. More specifically HSPF uses precipitation data for continuous and storm event simulation to determine total fecal loading to the Lower Blackwater River from urban areas, forest, good pasture, poor pasture, cropland, farmstead, loafing areas, and livestock access areas. The total land loading of fecal coliform is the result of the application of manure, direct deposition from cattle and wildlife (geese, deer, etc.) to the land, fecal coliform production from pets, fecal coliform from septic systems, and the application of biosolids.

The TMDL analysis allocates the application/deposition of fecal coliform to land-based and in-stream sources. For land-based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to the complex spectrum of dry-weather processes that deposit or remove pollutants between storms⁵. Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream and straight pipes.

Table #1 summarizes the specific elements of the TMDL at the watershed outlet.

Segment	Parameter	TMDL ¹	WLA(cfu/yr) ^{1,3}	LA (cfu/yr) ¹	MOS(cfu/yr) ^{1,2}
Lower Blackwater	Fecal Coliform	5.38E+14	1.81E+11	5.19E+14	1.91E+13

¹ The WLA, LA, MOS, and TMDL include loads from the South Fork Blackwater, North Fork Blackwater, Upper Blackwater, Middle Blackwater, Maggodee Creek, and Lower Blackwater watersheds. A first order decay rate (representing die-off, settlement, etc.) affects the

³MapTech, 2001. Fecal Coliform TMDL (Total Maximum Daily Load) Development for Lower Blackwater River, Virginia. Addendum B.

⁴ CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia.

⁵Supra, footnote #4.

loading in-stream. Therefore, even though the TMDL load for the Lower Blackwater is the summation of loads from all four upper stream segments, Maggodee Creek, and the Lower Blackwater itself it is still smaller than the TMDL load for Maggodee Creek alone.

2 Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

3 There are no point sources discharging to the impaired segment of the Lower Blackwater River, the WLA is based on the WLA values for the upstream waters.

EPA believes it is important to recognize the conceptual difference between waste load allocation (WLA) values, load allocation (LA) values for sources modeled as being directly deposited to the stream segment, and LA values for flux sources of fecal coliform to land use categories. WLA values and LA values for direct sources represent the amount of fecal coliform which is actually deposited into the stream segment. However, LA values for flux sources represent the amount of fecal coliform deposited to the land. The actual amount of fecal coliform which reaches the stream segment will be significantly less than the amount of fecal coliform deposited to the land. The HSPF model, which considers landscape processes which affect fecal coliform runoff from land uses, determines the amount of fecal coliform which reaches the stream segment. The LA in Table #1 is the amount of colony forming units reaching the stream outlet from nonpoint sources annually.

The United States Fish and Wildlife Service (USFWS) has been provided with a copy of this TMDL. A formal response from the USFWS has not been received.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all eight basic requirements for establishing a fecal coliform TMDL for the Lower Blackwater River. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (directly deposited to the River) have caused violations of the water quality standards and designated uses on the Lower Blackwater River. The water quality criterion for fecal coliform is a geometric mean 200 cfu (colony forming units)/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Therefore, most violations of the State's water quality standard are due to violations of the instantaneous standard.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to the Lower Blackwater River will ensure that the criterion is attained.

Fecal coliform production rates within the watershed are attained from a wide array of sources on the farm practices in the area (land application rates of manure), the amount and concentration of farm animals, point sources in the watershed, animal access to the stream,

wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc. This information is used in the development of the model.

The hydrology component of the model for all the Blackwater TMDLs was developed on United States Geologic Survey (USGS) gage #02056900 on the Blackwater River. The percent error of the simulated flow versus observed flow was within the acceptable limit of 10% and the calibration was deemed acceptable. The model was calibrated to USGS gage #02056900 data from October 01, 1994 through September 30, 1998. The model was then validated, applied to a different time period to determine if it still accurately reflected observed conditions, to USGS gage #02056900 data from January 01, 1991 to September 30, 1994 and October 01, 1980 to September 30, 1981.

A regression analysis was performed on instantaneous flow measurements at the USGS gage to flow measurements made at the watershed outlet by VADEQ. This was done to transform the USGS flow to the outlet of the impaired water, thus creating a continuous flow record. Water quality sampling was used to determine an average ratio of flow at the VADEQ monitoring stations to the watershed outlet. This process was then conducted for the simulated flow measurements. These ratios were then evaluated to determine the accuracy of the model on a finer (subwatershed) scale.

The water quality calibration was conducted using data from January 1, 1993 to December 31, 1995.⁶ Parameters such as the fecal coliform concentration in interflow, the intensity of rainfall that will cause 90% of the pollutant to be washed off, decay rate, and the maximum accumulation of a pollutant on the land surface were changed to create a better correspondence between observed and simulated conditions. The decay rate is used to simulate how settlement and die-off affect the in-stream loading. The first order decay rate influences the land-based and in-stream loading.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for the Lower Blackwater River.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based, precipitation driven nonpoint source areas (good pasture, poor pasture, cropland, forest, urban, farmstead, loafing lots, and livestock access), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, straight pipes, and lateral flow), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The

⁶MapTech, 2001.Fecal Coliform TMDL (Total Maximum Daily Load) Development for Lower Blackwater River, Virginia.

actual value for the total fecal load can be found in Table #1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

Virginia has stated that there are no regulated point sources discharging to the impaired segment of the Lower Blackwater River. It should be noted that there are regulated point sources discharging to the other impaired Blackwater River segments and that these point sources were given a WLA under their respective watersheds.

Load Allocations

According to federal regulations at 40 CFR 130.2 (g), load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, straight pipes, wildlife in-stream, and failed septic systems (lateral flow). These sources are not dependent on a transport mechanism to reach a surface waterbody and therefore can impact water quality during low and high flow events. As stated above a factor value was incorporated into the loading. This factor value was an attempt to address an unknown mechanism that increased the observed fecal coliform concentrations. The model developed for this TMDL used a factor value based on the likelihood that cattle in-stream were causing the resuspension of fecal coliform in the sediment. Table #2 illustrates the loading to each land use. The load that reaches the stream from each land use will be significantly smaller than the amount of fecal coliform deposited to the land. Table #2, represents the actual fecal coliform loading to each land use, the load allocation in Table #1 represents the portion of that loading which reaches the stream outlet.

Table #2 - Load allocation for the land application of fecal coliform

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Good Pasture	2.48E+15	2.48E+15	0%
Poor Pasture	8.92E+14	8.92E+14	0%
Cropland	4.70E+15	4.70E+15	0%
Forest	9.77E+14	9.77E+14	0%
Urban	9.94E+14	9.94E+14	0%
Farmstead	2.28+E13	2.28+E13	0%
Livestock Access ¹	6.93E+13	1.44E+14	-108%

Loafing Lot	4.30E+14	4.30E+14	0%
Straight Pipes	1.54E+13	0.00	100%
Lateral Flow	6.99E+08	6.99E+08	0%
Wildlife In-Stream	1.62E+13	1.62E+13	0%
Cattle In-Stream	4.87E+14	5.63E+13	89%

¹ Livestock access areas are areas where cattle currently have access to the stream. After the implementation of this TMDL, these areas will no longer provide the cattle with access to the stream. The increase in loading to this area is a result of the Cattle In-Stream load being applied to this land segment. This table documents the allowable loading to each land use, significantly smaller amount of fecal coliform will actually be reaching the stream.

3) The TMDL considers the impacts of background pollution.

A background concentration was set for all land segments by adding 10% of the total wildlife load to each land segment. Loading from the upstream reaches were treated as point sources.

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the Lower Blackwater River is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards⁷. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence but when modeled to insure that water quality standards will be met for the remainder of conditions. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable “worst-case” scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Therefore, the critical condition for the Lower Blackwater River was represented as a typical hydrologic year. However, the most stringent reductions were needed to insure that water quality standards were met during extreme low flows. It should be noted that low flow events occurred more often than wet weather events and therefore it was essential that the standard be maintained during these periods. Runoff events occurred less than 8% of the time, based on rainfall analysis from 1994-1999. Therefore, if the geometric mean of fecal coliform concentrations during non-runoff event periods is 100 cfu/100 ml, then the geometric mean of

⁷EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

fecal coliform concentrations during runoff events could be as much as 4 orders of magnitude greater and the Commonwealth's water quality standard (30-day, geometric mean < 200 cfu/100ml) would still be met⁸.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs during the early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis will effectively consider seasonal environmental variations.

The model also accounted for seasonal variations in fecal coliform loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter. Therefore, the loading from cattle in-stream was greatest in the summer when there were more cattle in the stream for longer periods of time. This loading was further enhanced by the low flows encountered during the summer months (Table 2.4 of the TMDL Report for the Lower Blackwater).

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the wasteload allocation, load allocation, or TMDL.

Virginia includes an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 ml. This would be considered an explicit 5% margin of safety.

7) The TMDLs have been subject to public participation.

Seven meetings were held to discuss the TMDL and TMDL process. There was one semi-public meeting, three public meetings associated with TMDL development on the upper four Blackwater segments, two public meetings on the Lower Blackwater and Maggoodee Creek, and a public meeting for a select group of farmers. Two one-hour programs and the February 16, 2000 meeting were televised for additional outreach. All of the public meetings were advertised in the *Virginia Register*.

⁸Supra, footnote #3.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the Clean Water Act, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.